IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants   :   Gregory J. Gerhard, Clarence T. Tegreene, Bashir Z. Eslam

Application No.   :   To Be Assigned

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For   :   SCANNED DISPLAY WITH PINCH, TIMING AND DISTORTION CORRECTION

Examiner   :   Kevin Nguyen

Art Unit   :   2674

Docket No.   :   MVIS 97-14 C2

Date   :   September 21, 2001

Box Patent Application
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Washington, DC 20231

PRELIMINARY AMENDMENT

Sir:

Prior to substantive examination of the above-identified patent application, please amend the application as follows:

In the Specification:

Please amend the specification by inserting before the first line the sentence: "This application is a continuation of application number 09/659,111, filed September 11, 2000."

In the Claims:

Please cancel claims 1-47 without prejudice. Please add new claims 48-61 as follows:

48. (New) A method for use in a scanning beam display of producing an image in response to image data that represent desired pixels, each desired pixel having a respective desired pixel location, comprising the steps of:

emitting a beam of light;

resonantly scanning the light along a first axis at a first frequency through a series of actual pixel locations;

for each actual pixel location identifying a plurality of desired pixel locations corresponding to the actual pixel location;

determining for each of the identified pluralities of desired pixel locations a corresponding set of weighted data as a function of the first frequency and the image data for the respective desired pixel location; and

modulating the beam of light according to the weighted data, when the beam of light is aligned with the corresponding actual pixel location.

49. (New) The method of claim 48 wherein the step of for each actual pixel location identifying a plurality of desired pixel locations corresponding to the actual pixel location includes identifying a first desired pixel location immediately preceding the actual pixel location and identifying a second desired pixel location immediately following the actual pixel.

50. (New) The method of claim 49 wherein the step of determining for each of the identified pluralities of desired pixel locations a corresponding set of weighted data as a function of the first frequency and the image data for the respective desired pixel location includes calculating a weighted average of the image data corresponding to the first and second desired pixel locations.

51.   (New) The method of claim 48 further including scanning the beam of light along a second axis substantially orthogonal to the first axis.

52.   (New) The method of claim 49 wherein determining for each of the identified pluralities of desired pixel locations a corresponding set of weighted data as a function of the first frequency and the image data for the respective desired pixel location includes clocking data out of a memory buffer.

53.   (New) A method of producing an image for viewing in response to a set of data representing pixels of an image, each pixel having a respective pixel location in a two dimensional matrix, comprising the steps of:

storing the data representing the pixels in a memory device;

emitting a light beam from a first position;

resonantly scanning the emitted light beam about at least one axis in a selected two dimensional scan pattern;

identifying a series of substantially equally spaced pixel times each corresponding to a respective location in the two dimensional scan pattern; and

for each of the identified substantially equally spaced pixel times, determining a corresponding weighted average of a plurality of the data; and

at each identified substantially equally spaced pixel times, modulating the light beam according to the determined corresponding weighted average.

54.   (New) The method of claim 53 wherein the memory device is a two dimensional buffer.

55.   (New) The method of claim 53 wherein modulating the light beam according to the determined corresponding weighted average includes gamma correcting the corresponding weighted average.

56.   (New) The method of claim 53 wherein emitting a light beam from a first position includes driving a light emitting diode with a driving current.

57.   (New) The method of claim 56 wherein modulating the light beam according to the determined corresponding weighted average includes modulating the driving current.

58.   (New) A method of producing a resonantly scanned image, comprising the steps of:

storing data representing a rectilinear set of pixels in a buffer;

for each line in the image, clocking the stored data out of the buffer at a set of equally spaced clocking times;

for each of the clocking times determining a location in a resonant scanning pattern; and

for each of the clocking times, calculating a pixel intensity that is a weighted average of a plurality of the clocked out stored data; and

substantially at each of the clocking times, emitting a beam of light that is modulated according to the corresponding calculated pixel intensity.

59.   (New) The method of claim 58 further including sweeping the beam of light through the resonant scanning pattern.

60.   (New) The method of claim 59 wherein sweeping the beam of light through the resonant scanning pattern includes redirecting the beam of light with at least one resonantly driven mirror.

61.   (New) The method of claim 58 wherein emitting a beam of light that is modulated according to the corresponding calculated pixel intensity includes gamma correcting the calculated pixel intensity.

REMARKS

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned **Version With Markings to Show Changes Made.**

Applicants submit that no new matter is being submitted. The Examiner is invited to contact Mr. Casey T. Tegreene at (425) 415-6621 with any issues that may advance prosecution of the application on the merits.

Respectfully submitted,

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Enclosures:
 Postcard
 Check
 Certificate of Mailing by Express Mail
 Request for Continuation (+ copy)
 Petition for Extension of Time (+ copy)
 Copy of Original Application (Spec, Claims and Abstract – 35 pgs.)
 Copy of 24 Sheets of Drawings (Figs. 1-28)
 Copy of Declaration and Power of Attorney
 Information Disclosure Statement
 Form PTO-1449 (Subst.)

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Application No. To Be Assigned

VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Specification:

Insert before first line of specification: This application is a continuation of application number 09/659,111, filed September 11, 2000.

In the Claims:

Please cancel claims 1-47.

1.   A method of producing an image for viewing, comprising the steps of:

emitting light from a first location;

resonantly scanning the light along a first axis at a first frequency;

scanning the light along a second axis different from the first axis at a second frequency, while scanning the light along the first axis;

scanning the light along the second axis at a third frequency that is an integral multiple of the first frequency, while scanning the light along the first axis; and

modulating the light in a pattern corresponding to the image, synchronously with the step of resonantly scanning the light along the second axis.

2.   The method of claim 1 wherein the step of scanning the light along the second axis at a third frequency includes resonantly scanning at the third frequency.

3.   The method of claim 1 wherein the step of scanning the light along the second axis at a third frequency includes the steps of:

scanning a turning mirror with a piezoelectric scanner at the third frequency; and

redirecting the light with the scanned turning mirror.

4. The method of claim 1 wherein the step of scanning the light along the second axis at a third frequency that is an integral multiple of the first frequency, while scanning the light along the first axis includes the steps of:

sensing a scanning position of the light along the first axis;

producing a driving signal in response to the sensed scanning position; and

scanning the light along the second axis in response to the produced driving signal.

5. The method of claim 4 wherein the step of producing a driving signal in response to the sensed scanning position includes the steps of:

producing a sense signal corresponding to the sensed scanning position; and

frequency doubling the sense signal.

6. A method of scanning a light beam in a substantially raster pattern, comprising the steps of:

emitting, from a first position, the light beam;

scanning the light beam about a first axis through a first angular range at a first rate with a first period;

scanning the light beam about a second axis orthogonal to the first axis through a second angular range at a second rate;

directing the emitted, scanned light toward the user's eye; and

scanning the light beam at a third rate at least as high as the first rate about the second axis at an amplitude selected to offset motion of the second scan during the first period.

7. The method of claim 6 wherein the third rate is twice the first rate.

8. ~~The method of claim 6 wherein the steps of scanning the light beam about a first axis through a first angular range at a first rate with a first period and scanning the light beam about a second axis orthogonal to the first axis through a second angular range at a second rate, include sweeping a mirror about both the first and second axes.~~

9. ~~The method of claim 6 wherein the step of scanning the light beam at a third rate at least as high as the first rate along the second axis at an amplitude selected to offset motion of the second scan during the first period includes the steps of:~~
~~determining the position of the beam about the first axis;~~
~~producing an electrical signal indicative of the determined position;~~
~~generating a drive signal in response to the electrical signal; and~~
~~driving a scanner with the drive signal to scan the light at the third rate.~~

10. ~~The method of claim 9 wherein the step of generating a driving signal includes the step of frequency doubling the electrical signal indicative of the position of the beam about the first axis.~~

11. ~~A method of scanning an optical path through a substantially rectilinear pattern, comprising the steps of:~~
~~scanning a first mirror periodically in a first direction at a first frequency, the first mirror being positioned to sweep the optical path about a first axis ;~~
~~scanning a second mirror continuously in a second direction while scanning the first mirror in the first direction, the second mirror being positioned to sweep the optical path about a second axis different from the first axis;~~
~~producing a scanning signal at a second frequency that is twice the first frequency of the first frequency; and~~
~~scanning a third mirror in response to the scanning signal, the third mirror being positioned to sweep the optical path about the second axis.~~

12. ~~The method of claim 11 wherein the first and second mirrors are the same mirror.~~

13.   ~~The method of claim 11 wherein the first and second mirrors are different~~
~~mirrors.~~

14.   ~~The method of claim 11 wherein the step of scanning a first mirror~~
~~periodically in a first direction at a first frequency, includes activating a resonant scanner.~~

15.   ~~The method of claim 11 wherein the step of scanning a third mirror in~~
~~response to the scanning signal, includes activating a resonant correction scanner having~~
~~a resonant frequency at the frequency of the scanning signal.~~

16.   ~~The method of claim 15 further including varying the resonant frequency~~
~~of the resonant correction scanner.~~

17.   ~~A method of scanning an optical path through a periodic pattern with a~~
~~scanning system including a mechanically resonant scanner having a resonant frequency,~~
~~comprising the steps of:~~
~~scanning the optical path through a field of view at the resonant frequency~~
~~along a first axis by activating the mechanically resonant scanner;~~
~~scanning, at a frequency lower than the resonant frequency, the optical~~
~~path along a second axis different from the first axis while performing the step of~~
~~scanning the optical path along the first axis by activating the mechanically resonant~~
~~scanner;~~
~~determining an the amount of scan of the optical path along the second~~
~~axis that occurs while the optical path scans once through the field of view;~~
~~producing a driving signal at a correction frequency that is an integral~~
~~multiple of the resonant frequency; and~~
~~scanning along the second axis at the correction frequency and with an~~
~~amplitude selected to offset the determined amount of scan.~~

18. ~~The method of claim 17 wherein the step of scanning along the second axis at the correction frequency and with an amplitude selected to offset the determined amount of scan, includes activating a resonant correction scanner having a resonant frequency at the correction frequency.~~

19. ~~The method of claim 15 further including varying the resonant frequency of the correction scanner.~~

20. ~~A scanner for scanning a beam of electromagnetic energy through a substantially raster pattern, comprising:~~

~~a first scanning assembly having a first mirror configured to pivot about a first axis and a second mirror configured to pivot about a second axis orthogonal to the first axis;~~

~~a second scanning assembly having a third mirror separate from the first mirror and the second mirror, the third mirror being pivotable about the first axis in response to a driving signal;~~

~~a position sensor having a sensing input coupled to the first mirror and a sensing output, the position sensor being responsive to movement of the first mirror about the first axis to produce an electrical signal at the sensing output corresponding to the position of the first mirror; and~~

~~a driving circuit having a signal input coupled to the sensing output and a driving output coupled to the second scanning assembly, the driving circuit being responsive to the electrical signal to produce the driving signal.~~

21. ~~The scanner of claim 20 wherein the first and second mirrors are the same mirror.~~

22. ~~The scanner of claim 20 wherein the first scanning assembly is a resonant assembly having a first resonant frequency.~~

23. The scanner of claim 22 wherein the third scanning assembly is a resonant assembly having a third resonant frequency.

24. The scanner of claim 23 wherein the third resonant frequency is twice the first resonant frequency.

25. The scanner of claim 24 wherein the first scanning assembly includes a first MEMs scanner.

26. The scanner of claim 25 wherein the third scanning assembly includes a third MEMs scanner.

27. The scanner of claim 25 wherein the first MEMs scanner is biaxial.

28. A scanning apparatus for scanning a beam in a substantially raster format, comprising:

a first scanning assembly having a first optical input and a first scan signal input, the first scanning assembly being configured to scan an optical beam substantially sinusoidally at a first frequency about a first axis and to scan the optical beam about a second axis orthogonal to the first axis; and

a corrective scanner positioned to receive the optical beam either before or after the first scanning assembly and configured to scan the beam about the second axis at a second frequency that is twice the first frequency.

29. The scanning apparatus of claim 28 wherein the corrective scanner has an angular range equal to an expected angle of travel of the first scanning assembly about the second axis during a single scan of the first scanning assembly about the first axis.

30. The scanning apparatus of claim 29 wherein the first scanning assembly includes a first reflective surface that pivots through a first angular range about the first axis.

31.   The scanning apparatus of claim 30 wherein the first reflective surface pivots through a second angular range about the second axis.

32.   The scanning apparatus of claim 30 wherein the first scanning assembly includes a second reflective surface that pivots through a second angular range about the second axis.

33.   The scanning apparatus of claim 29 wherein the first scanning assembly has a resonant mode at the first frequency.

34.   The scanning apparatus of claim 29 wherein the correction scanner has a resonant mode at twice the first frequency.

35.   The scanning apparatus of claim 30 wherein the first scanning assembly is a MEMs scanner.

36.   The scanning apparatus of claim 35 wherein the MEMs scanner is a biaxial scanner.

37.   The scanning apparatus of claim 36 wherein the MEMs scanner is a resonant scanner.

38.   The scanning apparatus of claim 30 wherein the first scanning assembly includes a sensor responsive to provide a sense signal indicative of the angle of the optical beam about the first axis.

39.   The scanning apparatus of claim 30 further including drive circuitry having an input coupled to the sensor and an output coupled to the correction scanner, the drive circuitry being responsive to the sense signal to produce an drive signal.

40.   The scanning apparatus of claim 39 wherein the drive circuitry includes a frequency doubling circuit.

41.   An imager for acquiring data corresponding to a target object, comprising:

a first scanning assembly having a first optical input and a first scan signal input, the first scanning assembly being configured to scan substantially at a first frequency about a first axis and to scan about a second axis different from the first axis;

imaging optics aligned to the first scanning assembly and configured to collect light from the target object direct the gathered light along an optical path including the first scanning assembly; and

a correction scanner positioned along the optical path and configured to redirect the gathered light along the second axis at a frequency and amplitude corresponding to an expected amount of scan of the first scanning assembly about the second axis during a half period of the first frequency.

42.   The imager of claim 41 wherein the first scanning assembly includes a biaxial scanner.

43.   The imager of claim 42 wherein the correction scanner scanner is a MEMs scanner.

44.   The imager of claim 42 wherein the biaxial scanner is a MEMs scanner.

45.   The imager of claim 41 wherein the first scanning assembly includes a pair of uniaxial scanners.

46.   The imager of claim 45 wherein the correction scanner scanner is a MEMs scanner.

47.   The imager of claim 41 for use in reading symbols, further comprising:

~~a photodetector oriented to detect the light redirected by the correction~~ ~~scanner, the photodetetor being of a type that produces an electrical signal indicative of~~ ~~the intensity of detected light;~~

~~control electronics coupled to the photodetector and responsive to the~~ ~~electrical signal to identify information represented by the symbol.~~

Please add new claims 48-61 as follows:

48.   (New) A method for use in a scanning beam display of producing an image in response to image data that represent desired pixels, each desired pixel having a respective desired pixel location, comprising the steps of:

emitting a beam of light;

resonantly scanning the light along a first axis at a first frequency through a series of actual pixel locations;

for each actual pixel location identifying a plurality of desired pixel locations corresponding to the actual pixel location;

determining for each of the identified pluralities of desired pixel locations a corresponding set of weighted data as a function of the first frequency and the image data for the respective desired pixel location; and

modulating the beam of light according to the weighted data, when the beam of light is aligned with the corresponding actual pixel location.

49.   (New) The method of claim 48 wherein the step of for each actual pixel location identifying a plurality of desired pixel locations corresponding to the actual pixel location includes identifying a first desired pixel location immediately preceding the actual pixel location and identifying a second desired pixel location immediately following the actual pixel.

50.   (New) The method of claim 49 wherein the step of determining for each of the identified pluralities of desired pixel locations a corresponding set of weighted data as a function of the first frequency and the image data for the respective desired pixel

location includes calculating a weighted average of the image data corresponding to the first and second desired pixel locations.

51.   (New) The method of claim 48 further including scanning the beam of light along a second axis substantially orthogonal to the first axis.

52.   (New) The method of claim 49 wherein determining for each of the identified pluralities of desired pixel locations a corresponding set of weighted data as a function of the first frequency and the image data for the respective desired pixel location includes clocking data out of a memory buffer.

53.   (New) A method of producing an image for viewing in response to a set of data representing pixels of an image, each pixel having a respective pixel location in a two dimensional matrix, comprising the steps of:

storing the data representing the pixels in a memory device;

emitting a light beam from a first position;

resonantly scanning the emitted light beam about at least one axis in a selected two dimensional scan pattern;

identifying a series of substantially equally spaced pixel times each corresponding to a respective location in the two dimensional scan pattern; and

for each of the identified substantially equally spaced pixel times, determining a corresponding weighted average of a plurality of the data; and

at each identified substantially equally spaced pixel times, modulating the light beam according to the determined corresponding weighted average.

54.   (New) The method of claim 53 wherein the memory device is a two dimensional buffer.

55.   (New) The method of claim 53 wherein modulating the light beam according to the determined corresponding weighted average includes gamma correcting the corresponding weighted average.

56.   (New) The method of claim 53 wherein emitting a light beam from a first position includes driving a light emitting diode with a driving current.

57.   (New) The method of claim 56 wherein modulating the light beam according to the determined corresponding weighted average includes modulating the driving current.

58.   (New) A method of producing a resonantly scanned image, comprising the steps of:

storing data representing a rectilinear set of pixels in a buffer;

for each line in the image, clocking the stored data out of the buffer at a set of equally spaced clocking times;

for each of the clocking times determining a location in a resonant scanning pattern; and

for each of the clocking times, calculating a pixel intensity that is a weighted average of a plurality of the clocked out stored data; and

substantially at each of the clocking times, emitting a beam of light that is modulated according to the corresponding calculated pixel intensity.

59.   (New) The method of claim 58 further including sweeping the beam of light through the resonant scanning pattern.

60.   (New) The method of claim 59 wherein sweeping the beam of light through the resonant scanning pattern includes redirecting the beam of light with at least one resonantly driven mirror.

61.   (New) The method of claim 58 wherein emitting a beam of light that is modulated according to the corresponding calculated pixel intensity includes gamma correcting the calculated pixel intensity.